PRESENT FORM OF THE WIND EROSION EQUATION

The Wind Erosion Equation (WEQ)

The present wind erosion equation is expressed as:

$E = f[(IKC)LV]$

where,

E is equal to the estimated average annual soil loss expressed as tons per acre per year. It is very important to note that the erosion rate (E) estimated by the WEQ is the average annual erosion rate from the field, and that annual erosion varies widely from year to year.

The soil erodibility index, **I**, is the potential annual wind erosion for a given soil under a given set of field conditions. This factor, expressed as the average annual soil loss (t/ac/yr) from a field area accounts for the inherent soil properties affecting erodibility. These properties include texture, organic matter, and calcium carbonate percentage. The given set of field conditions for which "I" is referenced is that of an isolated area that is unsheltered, wide, bare, smooth, level, loose, and uncrusted at a location where the climatic factor, C is equal to 100.

The ridge roughness factor, **K**, is a measure of the effect of ridges made by tillage and planting implements. It is expressed as a decimal ranging from 0.5 to 1.0.

The climatic factor, **C**, characterizes the climatic variables affecting erosivity, specifically windspeed and surface soil moisture. The factor for any given locality is expressed as a percentage of the C factor for Garden City, Kansas, which has a value of 100.

The unsheltered distance, **L**, considers the unprotected distance along the prevailing erosive wind direction across the area to be evaluated and the preponderance of the prevailing erosive winds.

The vegetative cover factor, **V**, considers the kind, amount, and orientation of vegetation. The vegetative cover is expressed in pounds per acre of flat small-grain residue equivalent.

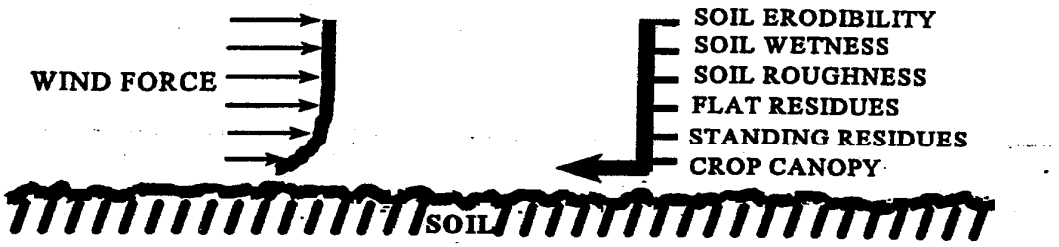

Figure 2. Opposing Forces in the Wind Erosion Process

Steps in Solving WEQ

Solving the wind erosion equation involves five successive steps as follows:

E1= (I) - Factor I is established for the specific soil. The value of I may be increased for knolls less than 500 feet long facing into the prevailing wind, or decreased to account for surface soil crusting, tillage-induced, and irrigation.

E2= (IK) - Factor K adjusts E1 for tillage-induced oriented roughness, K_{rd}, (ridges) and random roughness, K_{rr}. The value of K is calculated by multiplying K_{rd} times K_{rr} ($K= K_{rd} \times K_{rr}$).

E3= (IKC) - Factor C adjusts E2 to account for the local climate in relation to the reference condition (C=100).

Steps 1 through 3 can be solved by multiplying the values of factors I, K, and C.

E4= f[(IKC)L] - Factor L adjusts E3 for the unsheltered distance.

E5= f[(IKC)LV] - Factor V adjusts E4 for the vegetative cover.

Limitations of the WEQ

When the unsheltered distance, "L," is sufficiently long, the transport capacity of the wind for saltation and creep is reached. If the wind is transporting all of the soil it can carry across a given surface, the inflow into the downwind is equal to the outflow for saltation and creep. The net soil loss is then only the suspension component. This does not imply a reduced soil erosion problem because theoretically there is still the estimated amount of soil loss in creep, saltation, and suspension leaving the downwind edge of the field.

Another limitation is that surface armoring by non-erodible gravel is not usually addressed in the soil erodibility factor ("I"). Other limitations of the WEQ include the non-accounting for snow cover and inherent seasonal changes in the soil erodibility. The conservationist using the WEQ should also remember that the equation does not estimate soil erosion from single storm events.

Summary

Wind Erosion Equation E= f[(IKC)LV]

"E" - Estimated Average Annual Soil Loss in Tons per Acre per Year

The value "E" is an estimate of average annual tons of soil per acre that the wind will erode from an area represented by an unsheltered distance "L," for the soil, climate, and site conditions represented by "I," "K," "C," and "V." The equation is an empirical formula developed by relating wind tunnel data to observed field erosion during a 3-year period in the mid 1950's.

The field data was normalized to reflect long term average annual erosion assuming given conditions during the critical period without reference to changes in those conditions throughout the year. This calibration procedure accounted for minor changes expected to occur during a normal crop year at that time in history.

SOIL ERODIBILITY INDEX - "I"

Wind Erosion Equation $E = f[(IKC)LV]$

"I" is the erodibility factor for the given soil on a selected site.

"I" Factor Objectives

These materials will help the participant understand:

- The definition of the WEQ "I" Factor
- Adjustments to "I" that may:
  * increase "I" factor values
  * decrease "I" factor values
- The effect "I" has on soil erosion rates

"I" Soil Erodibility Index

"I" expresses the average annual wind erosion loss in tons per acre per year that would occur on a given soil and site assuming that the site were:

- "Wide" (the distance at which the flow of eroding soil reaches its maximum and does not increase with field width)
- Level (there are no knolls present)
- Unsheltered (there are no barriers present)
- Isolated (there is no incoming saltation)
- Bare (there is no vegetative cover present)
- Smooth (there are no effects from ridge roughness)
- Loose and non crusted (the soil aggregates are not bound together and the surface is not crusted)
- At a location where "C" is 100 (Garden City, Kansas)

"I" Soil Erodibility Index

This factor is related to the percentage of non-erodible surface soil aggregates larger than 0.84 mm in diameter. The percentage of non-erodible soil aggregates is determined by sieving an air dry sample of soil through a sieve with a mesh that is .84 mm. The sample is weighed first and the aggregates that do not sieve though the screen are weighed again. A percentage can then be calculated. This procedure is outlined in the National Agronomy Manual Part 502.61(b). Table 1 illustrates the relationship of the percent of non-erodible aggregates (> 0.84 mm) to assigned "I" factors. For example, the "I" value for a soil with 25 percent non-erodible aggregates is 86.